CELL STRUCTURE OF SOLID POLYMER ELECTROLYTIC FUEL CELL

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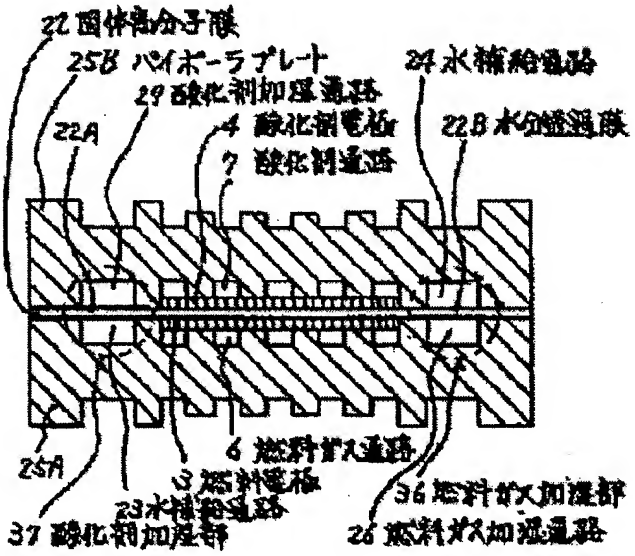
Abstract of **JP6068896**

PURPOSE:To provide a solid polymer electrolytic fuel cell for which a humidification part, which is easily assembled and has good humidification ability, and which also contributes to cooling of the fuel cell, is integrated therein. CONSTITUTION:A plurality of solid polymeric films 22 having ion conductivity, and a plurality of single cells consisting of a fuel electrode 3 and an oxidant electrode 4 that are adhered to the both surfaces of the film 22, are formed through bipolar plates 25A, 25B having a fuel gas channel 6 consisting of recessed groove and an oxidant channel 7, in the part opposed to the fuel electrode and to the oxidant electrode on the both surfaces of a gas non-permeation plate. The solid polymeric film 22 is extended to a fixed length in the both directions of the fuel electrode 3 and the oxidant electrode 4 which are opposed to one another, and a humidification part 36 of fuel gas is provided on the side of one extended part 22B while a humidification part 37 of oxidant is provided on the side of the other extended part 22A, with the extended parts serving as water permeation films.



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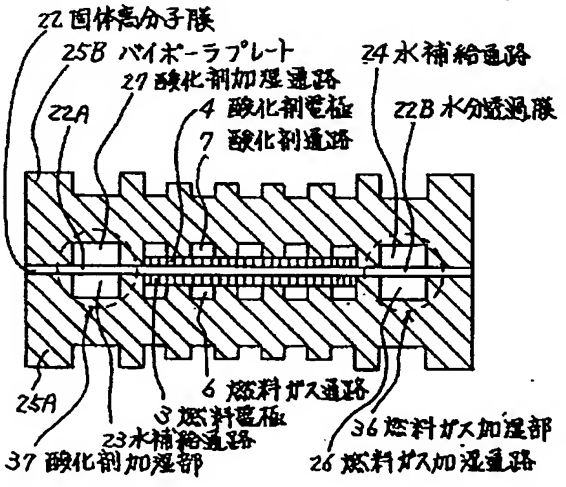
(54)【発明の名称】　固体高分子電解質型燃料電池のセル構造

(57)【要約】
【目的】組立作業が容易で、加湿性能がよく、燃料電池の冷却にも寄与できる加湿部が一体化された固体高分子電解質型燃料電池を得る。
【構成】イオン導電性を有する固体高分子膜２２と、その両面に密着して配された燃料電極３および酸化剤電極４とからなる単セルが、ガス不透過性板の両面の燃料電極および酸化剤電極それぞれに対向する部分に凹溝からなる燃料ガス通路６および酸化剤通路７を有するバイポーラプレート２５Ａ，２５Ｂを介して複数層積層された固体高分子電解質型燃料電池において、固体高分子膜が互いに対向する燃料電極および酸化剤電極の両側方に所定の長さ延長され、この延長部分を水分の透過膜として一方の延長部分２２Ｂ側に燃料ガスの加湿部３６，他方の延長部分２２Ａ側に酸化剤の加湿部３７を設けてなるものとする。



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【特許請求の範囲】

【請求項1】イオン導電性を有する固体高分子膜と、その両面に密着して配された燃料電極および酸化剤電極とからなる単セルが、ガス不透過性板の両面の前記燃料電極および酸化剤電極それぞれに対向する部分に凹溝からなる燃料ガス通路および酸化剤通路を有するバイポーラプレートを介して複数層積層された固体高分子電解質型燃料電池において、前記固体高分子膜が互いに対向する前記燃料電極および酸化剤電極の両側方に所定の長さ延長され、この延長部分を水分の透過膜として一方の延長部分に燃料ガスの加湿部，他方の延長部分に酸化剤の加湿部を設けてなることを特徴とする固体高分子電解質型燃料電池のセル構造。

【請求項2】加湿部が、固体高分子膜の延長部分と、これを挟持する一方のバイポーラプレートに燃料ガス通路または酸化剤通路に連通する凹溝として形成されたガス加湿通路と、他方のバイポーラプレートの前記ガス加湿通路に対向する部分に独立した凹溝として形成された水補給通路とからなることを特徴とする請求項1記載の固体高分子電解質型燃料電池のセル構造。

【請求項3】固体高分子膜の2つの延長部分におけるガス加湿通路および水補給通路の配置が、固体高分子膜に対して互いに対称な位置に配されて、一方が燃料ガスの加湿部を、他方が酸化剤の加湿部を形成してなることを特徴とする請求項2記載の固体高分子電解質型燃料電池のセル構造。

【請求項4】ガス加湿通路が、これを通った燃料ガスまたは酸化剤がUターンして燃料ガス通路または酸化剤通路に流入するよう形成されてなることを特徴とする請求項2記載の固体高分子電解質型燃料電池のセル構造。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は、固体高分子膜を電解質膜として用いた固体高分子電解質型燃料電池スタック、ことに固体高分子膜を加湿するためのセル構造に関する。

【0002】

【従来の技術】図4は固体高分子電解質型燃料電池の単セル構造を模式化して示す断面図であり、単セル1は、イオン導電性を有する固体高分子膜2と、その両面に密着するよう支持された燃料電極（アノード電極）3および酸化剤電極（カソード電極）4とで構成される。また、単セル1を挟持するバイポーラプレート5は導電性を有するガス不透過性板からなり、その燃料電極3に接する面側に凹溝として形成された燃料ガス通路6に燃料ガスとしての水素を、酸化剤電極4に接する面側に凹溝として形成された酸化剤通路7に酸化剤としての酸素を供給することにより、単セル1の一対の電極間で電気化学反応に基づく発電が行われる。なお、このように構成された単セル1の出力電圧は1V以下と低いので、単セル1とバイポーラプレート5を複数層積層してスタックを構成することにより、所望の出力電圧の固体高分子電解質型燃料電池が得られる。

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【0003】一方、イオン導電性を有する固体高分子膜1としては、例えばプロトン交換膜であるパーフロロカーボンスルホン酸膜（米国，デュポン社，商品名ナフィオン）を電解質膜として用いたものが知られており、分子中にプロトン（水素イオン）交換基を持ち、飽和含水することにより常温で20Ω-cm 以下の比抵抗を示し、プロトン導電性電解質として機能するとともに、燃料ガスと酸化剤ガスの混合を防ぐ隔膜としても機能する。すなわち、アノード電極（燃料電極）側では水素分子を水素イオンと電子に分解するアノード反応（$H_2 \rightarrow 2H^+ + 2e^-$）が、カソード電極（酸化剤電極）側では酸素と水素イオンと電子から水を生成する電気化学反応（$2H^+ + 1/2\ O_2 + 2e^- \rightarrow H_2O$）なるカソード反応がそれぞれ行われ、全体として$H_2 + 1/2\ O_2 \rightarrow H_2O$なる電気化学反応が行われ、アノードからカソードに向かって外部回路を移動する電子により発電電力が負荷に供給される。

【0004】上述のように、固体高分子電解質型燃料電池では、電解質膜を飽和含水させることにより、膜はプロトン交換膜として機能するものであるから、固体高分子電解質型燃料電池の発電効率を高く維持するためには固体高分子膜2中を飽和含水状態に維持するとともに、固体高分子電解質型燃料電池の運転温度を50～100°C 程度に保持して固体高分子膜の比抵抗を低く保つ必要がある。このため、各単セル1の固体高分子電解質膜2はあらかじめ飽和量の水を含水させた状態でスタックの組立作業が行われる。ところが、運転温度を上記温度範囲に高めて発電を行うと、下記に示す固体高分子膜2の乾燥作用が発生し、固体高分子膜2を飽和含水状態に維持できず固体高分子電解質型燃料電池の発電効率が低下するという問題が発生する。すなわち、燃料ガスおよび酸化剤ガスにより電気化学反応で生成した水が系外に持ち出されるとともに、アノード反応において生成したプロトン$2H^+$が固体高分子膜中をアノードからカソードに向けて移動する際、プロトンに数分子の水が配向して一緒に移動し、燃料ガス，酸化剤とともに系外に持ち出されることにより、固体高分子膜の乾燥が進行する。

【0005】そこで、このような事態を回避するために、反応ガス通路6および7に供給する反応ガス（燃料ガスおよび酸化剤）に水を添加して反応ガス中の水蒸気濃度（水蒸気分圧）を高め、固体高分子膜2からの水分の蒸発を抑えるよう構成したものが知られている。反応ガスの加湿方法としては、燃料電池の外部に温湯を溜めたタンクを用意し、この湯の中に反応ガスをバブリンクして加湿し、加湿した反応ガスを固体高分子電解質型燃料電池の各単セルに供給する外部加湿法が知られている。また、固体高分子電解質型燃料電池に隣接して加湿

部を設け、ここで加湿した反応ガスを各単セルに供給する内部加湿法も知られている。

【０００６】図５は内部加湿方式の従来の固体高分子電解質型燃料電池を示す模式図、図６は従来の内部加湿方式における加湿部を示す模式図である。図において、固体高分子電解質型燃料電池１０はその側壁に隣接して反応ガスの加湿部１１を備え、加湿した燃料ガスおよび酸化剤を各単セルの燃料ガス通路６および酸化剤通路７にそれぞれ供給する。加湿部１１は図６に示すように、電子導電性を持たない固体高分子膜（メンブランフィルター）を加湿用水透過膜１２Ａ，１２Ｂとし、それぞれ一方の面側が加湿水通路１３に対向し、他方の面が燃料ガス加湿室１６または酸化剤加湿室１７に対向するよう構成され、燃料電池の排熱により加熱された水により湿潤した加湿用水透過膜１２表面から水蒸気が発生し、この水蒸気により加湿された燃料ガスおよび酸化剤が固体高分子電解質型燃料電池１０の各単セルの燃料ガス通路６および酸化剤通路７にそれぞれ供給される。

【０００７】

【発明が解決しようとする課題】上述の外部加湿方式においては、タンクで加湿した反応ガスが燃料電池との間の配管中で凝縮するのを防ぐために、配管の断熱および加熱を必要とし、かつタンクの加熱用熱源を必要とするため、固体高分子電解質型燃料電池の熱効率の低下を招くという問題があり、かつ装置も大掛かりになるという欠点がある。

【０００８】一方上述の内部加湿方式においては、加湿部を燃料電池スタックに隣接して配置するので、水蒸気発生の熱源としての燃料電池の排熱の利用が容易であり、かつ加湿部と燃料電池の間のガス配管も簡単化できる利点がある。しかしながら、燃料電池とは別体のイオン導電性を持たない高分子膜を水分透過膜として使用した独立した装置であり、その部品点数も多く，組立作業が煩雑になるという問題がある。また、加湿部を単セルの層間に積層できれば、加湿用の補給水の蒸発潜熱を燃料電池の冷却に利用することが可能であり、加湿部を冷却板に兼用できると期待されるが、加湿用水透過膜が電子導電性を持たないため、単セルの層間に積層するとスタックの導電性が失われるため、加湿部を燃料電池の冷却板として兼用できないという問題も存在する。

【０００９】この発明の目的は、燃料電池スタックと一体化することにより、組立作業が容易で、加湿性能がよく、燃料電池の冷却にも寄与できる加湿部を備えた固体高分子電解質型燃料電池のセル構造を得ることにある。

【００１０】

【課題を解決するための手段】上記課題を解決するために、この発明によれば、イオン導電性を有する固体高分子膜と、その両面に密着して配された燃料電極および酸化剤電極とからなる単セルが、ガス不透過性板の両面の前記燃料電極および酸化剤電極それぞれに対向する部分

に凹溝からなる燃料ガス通路および酸化剤通路を有するバイポーラプレートを介して複数層積層された固体高分子電解質型燃料電池において、前記固体高分子膜が互いに対向する前記燃料電極および酸化剤電極の両側方に所定の長さ延長され、この延長部分を水分の透過膜として一方の延長部分に燃料ガスの加湿部，他方の延長部分に酸化剤の加湿部を設けてなるものとする。

【００１１】また、加湿部が、固体高分子膜の延長部分と、これを挟持する一方のバイポーラプレートに燃料ガス通路または酸化剤通路に連通する凹溝として形成されたガス加湿通路と、他方のバイポーラプレートの前記ガス加湿通路に対向する部分に独立した凹溝として形成された水補給通路とからなるものとする。さらに、固体高分子膜の２つの延長部分におけるガス加湿通路および水補給通路の配置が、固体高分子膜に対して互いに対称な位置に配されて、一方が燃料ガスの加湿部を、他方が酸化剤の加湿部を形成してなるものとする。

【００１２】さらにまた、ガス供給通路を、これを通った燃料ガスまたは酸化剤がＵターンして燃料ガス通路または酸化剤通路に流入するよう形成してなるものとする。

【００１３】

【作用】この発明の構成において、固体高分子電解質型燃料電池の各単セルのイオン導電性を有する固体高分子膜を、燃料電極および酸化剤電極の両側方に所定の長さ延長し、この延長部分を水分の透過膜として一方の延長部分に燃料ガスの加湿部，他方の延長部分に酸化剤の加湿部を設けるよう構成した。すなわち、固体高分子膜を挟持する一方のバイポーラプレートに燃料ガス通路または酸化剤通路に連通する凹溝として形成されたガス加湿通路を、他方のバイポーラプレートのガス供給通路に対向する部分に独立した凹溝として形成された水補給通路とを設けて加湿部とするよう構成すれば、バイポーラプレートにあらかじめ形成する凹溝の形状をガス加湿通路，水補給通路に対応して形成しておくことにより、固体高分子電解質型燃料電池の積層構造を殆ど変えることなく一体化された反応ガスの加湿部を単セル毎に備えた固体高分子電解質型燃料電池を構成できるので、部品点数および組立工数の増加を回避する機能が得られる。また、各単セル毎に加湿部備えるので固体高分子膜の加湿性能に優れ、かつ固体高分子膜の延長部分から本体部分への水分の移行も期待できるので固体高分子膜の高い乾燥防止機能が得られる。さらに、単セルの両サイドに一体化した加湿部が、単セルの発電生成熱を水蒸気の蒸発潜熱として奪うので、加湿部が応答速度の速い冷却板を兼ね、固体高分子電解質型燃料電池の温度分布を改善する機能が得られる。

【００１４】さらに、固体高分子膜の２つの延長部分におけるガス供給通路および水補給通路の配置を、固体高分子膜に対して互いに対称な位置とするよう構成すれ

ば、一方の延長部分に燃料ガスの加湿部を、他方の延長部分に酸化剤の加湿部を、固体高分子電解質型燃料電池の構成に影響を及ぼさずに形成することができる。さらにまた、ガス供給通路を、これを通った燃料ガスまたは酸化剤がUターンして燃料ガス通路または酸化剤通路に流入するよう形成すれば、加湿した反応ガスの供給通路を必要とせず、加湿部の所要面積を必要最小限に縮小できるとともに、水分を凝縮させることなく反応ガス通路に供給して固体高分子膜を効率よく加湿する機能が得られる。

【0015】

【実施例】以下、この発明を実施例に基づいて説明する。図1はこの発明の実施例になる固体高分子電解質型燃料電池のセル構造を模式化して示す断面図、図2は実施例におけるバイポーラプレートを燃料ガス通路側から見た平面図、図3は実施例におけるバイポーラプレートを酸化剤通路側から見た平面図であり、従来技術と同じ構成部分には同一参照符号を付すことにより、重複した説明を省略する。図において、単セルを構成するイオン導電性を有する固体高分子膜22が、これを介して互いに対向する燃料電極3および酸化剤電極4の両側方に所定の長さ延長され、この延長部分を水分の透過膜22A，22Bとして一方の延長部分に燃料ガスの加湿部36，他方の延長部分に酸化剤の加湿部37が形成される。

【0016】燃料ガスの加湿部36は、固体高分子膜22の延長部分22Bを水分の透過膜とし、これを挟持する一方のバイポーラプレート25Aに燃料ガス通路6に連通する凹溝としての燃料ガス加湿通路26を形成し、他方のバイポーラプレート25Bの燃料ガス加湿通路26に対向する部分に独立した凹溝からなる水補給通路24を形成することにより、各単セルと一体化した燃料ガスの加湿部36を備えた固体高分子電解質型燃料電池が構成される。また、酸化剤の加湿部37としては、固体高分子膜22の延長部分22Aを水分の透過膜とし、これを挟持する一方のバイポーラプレート25Bに酸化剤通路7に連通する凹溝としての酸化剤加湿通路27を形成し、他方のバイポーラプレート25Aの酸化剤加湿通路27に対向する部分に独立した凹溝からなる水補給通路23を形成することにより、各単セルと一体化した燃料ガスの加湿部37を備えた固体高分子電解質型燃料電池が構成される。

【0017】また、1つの単セルにおける燃料ガスの加湿部36および酸化剤の加湿部37は、固体高分子膜の2つの延長部分におけるガス加湿通路26，27と、水補給通路23，24との配置を、固体高分子膜に対して互いに対称な位置とすることにより、燃料ガス通路6に連通した燃料ガス加湿通路26と、酸化剤通路7に連通した酸化剤加湿通路27とを1枚の固体高分子膜22の延長部分を利用する形で形成することができる。

【0018】さらに、図2または図3に示すように、水補給通路23，24はバイポーラプレート25A，25B外周側のシール部28に連結して形成されたリブ28Bにより、ガス通路6，7と画成され、シール部28を貫通する補給水の入口23A，24Aと、出口23B，24Bを介して補給水の給排水がそれぞれ行われる。また、燃料ガスの加湿通路26，または酸化剤の加湿通路27は、燃料ガス通路6，酸化剤通路7との間にリブ28Aを備え、加湿通路を通った燃料ガスまたは酸化剤がUターンして燃料ガス通路6または酸化剤通路7に流入するよう形成され、加湿通路で加湿された反応ガス中の水分を凝縮させることなく燃料ガス通路または酸化剤通路に供給できるとともに、加湿部が占める面積を最小限度に縮小することができる。

【0019】実施例になるセル構造を有する単セルは、加湿部36および37中の補給水が、単セルの発電生成熱を単セルから直接，あるいは図示しない冷却板の延長部分から受けて加熱され、湿潤した水分透過膜22A，22Bの表面で水蒸気が発生し、この水蒸気により加湿通路26，27内の反応ガスが加湿され、これに連通した燃料ガス通路6および酸化剤通路7に加湿された燃料ガスまたは酸化剤が供給される。

【0020】このように構成されたセル構造を有する単セルの積層体として構成される固体高分子電解質型燃料電池においては、バイポーラプレートにあらかじめ形成する凹溝の形状をガス加湿通路，水補給通路に対応して形成しておくことにより、固体高分子電解質型燃料電池の積層構造を殆ど変えることなく一体化された反応ガスの加湿部を単セル毎に備えた固体高分子電解質型燃料電池を構成できるので、部品点数および組立工数の増加が回避されて製造コストの低減が可能になるとともに、各単セル毎に加湿部が設けられて反応ガスの加湿性能がよく、かつ湿潤した延長部分から直接水分が固体高分子膜の本体部分に移行して乾燥を防止する機能が加わるので、高度の乾燥防止性能を有するセル構造を備えた固体高分子電解質型燃料電池を経済的にも有利に得ることができる。

【0021】また、単セルの両サイドに一体化した加湿部が、単セルの発電生成熱を水蒸気の蒸発潜熱として奪うので、加湿部が応答速度の速い冷却板の機能を兼ね、固体高分子電解質型燃料電池の温度分布を改善できる利点が得られる。

【0022】

【発明の効果】この発明は前述のように、電解質膜としての固体高分子膜の延長部分を水分の透過膜として一方の延長部分に燃料ガスの加湿部，他方の延長部分に酸化剤の加湿部を設けるよう構成した。その結果、外部加湿方式の固体高分子電解質型燃料電池に比べ、加湿部が燃料電池と一体化されることにより加湿タンクおよびガス配管を必要とせず装置の構成を簡素化できるとともに、

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燃料電池の生成熱を水蒸気発生用熱源として直接利用できるので熱効率が高く、かつ加湿部を各単セルが備えることにより加湿性能の高いセル構造を備えた固体高分子電解質型燃料電池を経済的にも有利に提供することができる。

【００２３】また、燃料電池に加湿部を併設した従来の内部加湿方式の固体高分子電解質型燃料電池に比べ、燃料電池本体と一体化した加湿部を各単セル毎に備え、かつ燃料電池の生成熱を水蒸気発生用熱源として直接利用できるため、単セル温度の変化に対する加湿量の応答速度高く、固体高分子膜の延長部分から本体部分への水分の直接補給も期待できるので、優れた固体高分子膜の乾燥防止効果が得られる。また、一体化されることにより部品点数およびその組立工数を低減できるので、製造コストを大幅に低減できる経済効果が得られる。さらに、加湿部に供給される補給水が冷却水としても機能するので、各単セルに冷却板を設けたと同様の冷却効果が得られ、単セルの面方向および固体高分子電解質型燃料電池の積層方向の温度分布を改善してセル特性を向上する波及効果も期待できる。

【図面の簡単な説明】

【図１】この発明の実施例になる固体高分子電解質型燃料電池のセル構造を模式化して示す断面図

【図２】実施例におけるバイポーラプレートを燃料ガス通路側から見た平面図

【図３】実施例におけるバイポーラプレートを酸化剤通路側から見た平面図

【図４】固体高分子電解質型燃料電池の単セル構造を模式化して示す断面図

【図５】内部加湿方式の従来の固体高分子電解質型燃料電池を示す模式図

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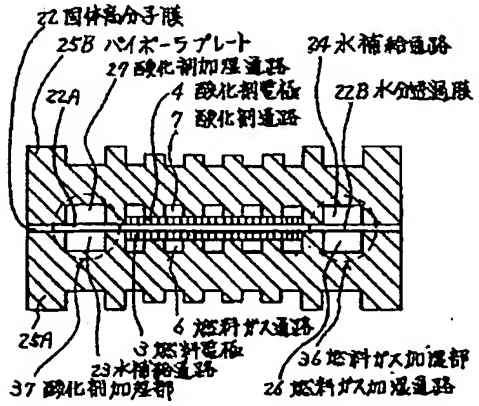
【図６】従来の内部加湿方式における加湿部を示す模式図

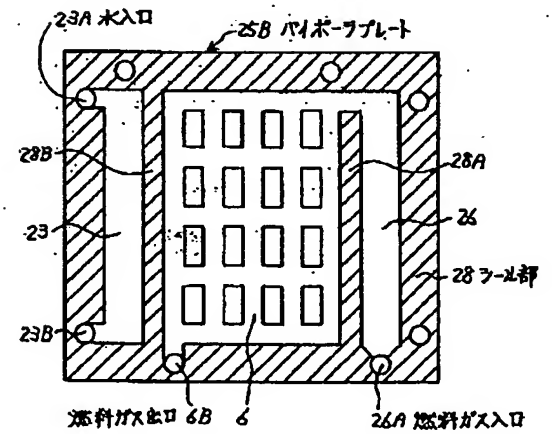
【符号の説明】

１	単セル
２	固体高分子膜
３	燃料電極
４	酸化剤電極
５	バイポーラプレート
６	燃料ガス通路
７	酸化剤通路
８	ガスシール部（リブ）
１０	固体高分子電解質型燃料電池（スタック）
１１	加湿部
１２	加湿用水透過膜
１３	加湿水通路
１６	燃料ガス加湿室
１７	酸化剤加湿室
２２	固体高分子膜
２２Ａ	固体高分子膜の延長部分（水分透過膜）
２２Ｂ	固体高分子膜の延長部分（水分透過膜）
２３	水補給通路
２４	水補給通路
２５Ａ	バイポーラプレート
２５Ｂ	バイポーラプレート
２６	燃料ガス加湿通路
２７	酸化剤加湿通路
２８	シール部
２８Ａ	リブ（ガスUターン用）
２８Ｂ	リブ（水補給通路の画成用）
３６	燃料ガス加湿部
３７	酸化剤加湿部

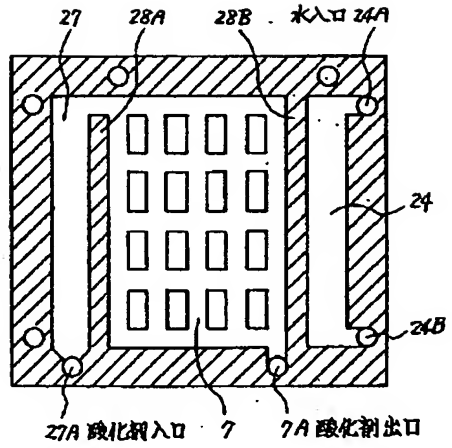
【図１】



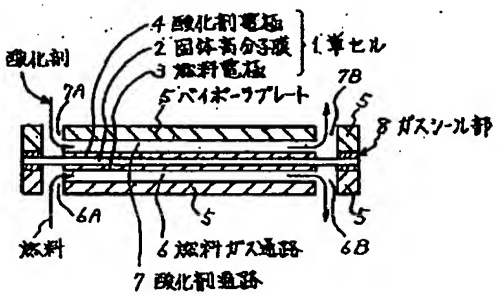
【図２】



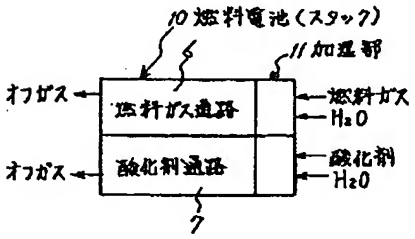
【図3】


27
28A
28B
水入口 24A
24
24B
27A 酸化剤入口
7
7A 酸化剤出口

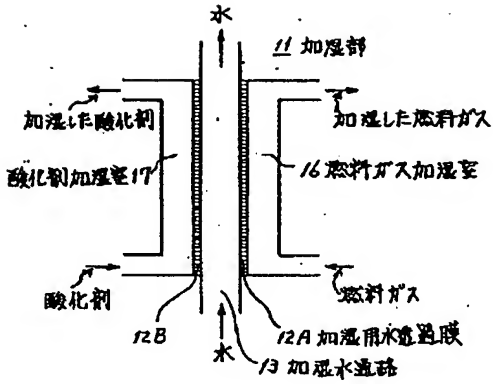
【図4】


4 酸化剤電極
2 固体高分子膜
3 燃料電極
1単セル
酸化剤
7A
5 バイポーラプレート
7B
5
8 ガスシール部
6A
5
5
燃料
6 燃料ガス通路
6B
7 酸化剤通路

【図5】


10 燃料電池(スタック)
11 加湿部
オフガス
燃料ガス通路
燃料ガス
H2O
オフガス
酸化剤通路
酸化剤
H2O
7

【図6】


水
11 加湿部
加湿した酸化剤
加湿した燃料ガス
酸化剤加湿室17
16 燃料ガス加湿室
酸化剤
燃料ガス
12B
12A 加湿用水透過膜
水
13 加湿水通路

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1]Solid polymer membrane which has ion conductivity.
A fuel gas passage and an oxidizing agent passage where a single cell which consists of a fuel electrode and an oxidant electrode which were arranged by sticking to the both sides becomes a portion which counters each said double-sided fuel electrode and oxidant electrode of a gas impermeability board from a concave.
Length extension of predetermined is carried out at a method of both sides of said fuel electrode and an oxidant electrode in which it is the cellular structure of a solid polyelectrolyte type fuel cell provided with the above, and said solid polymer membrane counters mutually, As a transmission film of moisture, this extension is provided in one extension and a humidifying section of an oxidizer is provided in a humidifying section of fuel gas, and an extension of another side.

[Claim 2]The cellular structure of the solid polyelectrolyte type fuel cell according to claim 1 characterized by comprising the following.
A humidifying section is an extension of solid polymer membrane.
A gas humidifying passage formed as a concave which while pinches this and is open for free passage to a bipolar plate in a fuel gas passage or an oxidizing agent passage.
A water replenish passage formed as a concave which became independent into a portion which counters said gas humidifying passage of a bipolar plate of another side.

[Claim 3]Arrangement of a gas humidifying passage in two extensions of solid polymer membrane and a water replenish passage, The cellular structure of the solid polyelectrolyte type fuel cell according to claim 2 which it is mutually allotted to a symmetric position to solid polymer membrane, and one side forms a humidifying section of fuel gas, and another side forms a humidifying section of an oxidizer, and is characterized by things.
[Claim 4]The cellular structure of the solid polyelectrolyte type fuel cell according to claim 2 being formed and becoming so that fuel gas or an oxidizer in which a gas humidifying passage passed along this may make a U-turn and it may flow into a fuel gas passage or an oxidizing agent passage.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the solid polyelectrolyte type fuel cell stack which used solid polymer membrane as an electrolyte membrane, and the cellular structure for humidifying solid polymer membrane especially.
[0002]
[Description of the Prior Art]Drawing 4 is a sectional view [-izing / **/ the single-cell-structure of a solid polyelectrolyte type fuel cell / a sectional view / type / in which showing it] and and, and the single cell 1 comprises the solid polymer membrane 2 which has ion conductivity, and the fuel electrode (anode electrode) 3 and the oxidant electrode (cathode terminal) 4 which were supported so that it might stick to the both sides. The bipolar plate 5 which pinches the single cell 1 consists of a gas impermeability board which has conductivity, Power generation based on electrochemical reaction is performed by inter-electrode [of the couple of the single cell 1] by supplying oxygen as an oxidizer to the oxidizing agent passage 7 formed in the fuel gas passage 6 formed in the field side which touches the fuel electrode 3 as a concave as a concave in hydrogen as fuel gas at the field side which touches the oxidant electrode 4. Since the output voltage of the single cell 1 constituted in this way is as low as less than 1V, the solid polyelectrolyte type fuel cell of desired output voltage is obtained by laminating the single cell 1 and the two or more layers bipolar plate 5, and constituting a stack.
[0003]On the other hand as the solid polymer membrane 1 which has ion conductivity, For example, the thing using the perphloro carbon sulfonic acid film (the U.S., Du Pont, trade name Nafion) which is proton exchange membrane as an electrolyte membrane is known, While the specific resistance of 20 or less ohm-cm is shown and functioning as a proton conductivity electrolyte at ordinary temperature by having and carrying out the saturation water of the proton (hydrogen ion) exchange group into a molecule, it functions also as barrier membrane which prevents mixing of fuel gas and oxidant gas. Namely, the anode reaction ($H_2 \rightarrow 2H^+ + 2e^-$) which decomposes a hydrogen content child into a hydrogen ion and an electron in the anode electrode (fuel electrode) side, in the cathode terminal (oxidant electrode) side, water is generated from oxygen, a hydrogen ion, and an electron -- electrochemical reaction ($2H^+ + 1/2\ O_2 + 2e^- \rightarrow H_2O$) -- a cathode reaction being performed, respectively and, Electrochemical reaction which $2\ O_2 \rightarrow H_2O$ [$H_2 + 1/$] Becomes as a whole is performed, and generated output is supplied to load with the electron which moves toward a cathode in an external circuit from an anode.
[0004]As mentioned above, **********, While maintaining the inside of the solid polymer membrane 2 to a saturation moisture state in order to maintain highly the generation efficiency of a solid polyelectrolyte type fuel cell since a film functions as proton exchange membrane by carrying out the saturation water of the electrolyte membrane, It is necessary to hold the operating temperature of a solid polyelectrolyte type fuel cell to a 50-100 degreeC grade, and to keep the specific resistance of solid polymer membrane low. For this reason, after the solid polyelectrolyte membrane 2

of each single cell 1 has carried out the water of the water of a saturation content beforehand, assembly operation of a stack is performed. However, if it generates electricity by raising an operating temperature to the above-mentioned temperature requirement, the drying effect of the solid polymer membrane 2 shown below occurs, the solid polymer membrane 2 cannot be maintained to a saturation moisture state, but the problem that the generation efficiency of a solid polyelectrolyte type fuel cell falls will occur. Namely, while the water generated by electrochemical reaction with fuel gas and oxidant gas is carried out out of a system, When proton $2H^+$ generated in the anode reaction turns the inside of solid polymer membrane to a cathode from an anode and moves, desiccation of solid polymer membrane advances by a child's water carrying out orientation to a proton several minutes, moving to it together, and being carried out out of a system with fuel gas and an oxidizer.

[0005]Then, in order to avoid such a situation, water is added to the reactant gas (fuel gas and oxidizer) supplied to the reactant gas passages 6 and 7, the steam concentration (steam partial pressure) in reactant gas is raised, and what was constituted so that evaporation of the moisture from the solid polymer membrane 2 might be suppressed is known. The tank which collected warm water is prepared for the exterior of a fuel cell as a humidifying method of reactant gas, and the external humidifying method which supplies the reactant gas which BABURINKU, humidified and humidified reactant gas in this hot water to each single cell of a solid polyelectrolyte type fuel cell is known. A solid polyelectrolyte type fuel cell is adjoined, a humidifying section is provided, and the internal humidifying method which supplies the reactant gas humidified here to each single cell is also known.

[0006]The mimetic diagram and drawing 6 in which the solid polyelectrolyte type fuel cell of the former [drawing 5] of an internal humidification method is shown are a mimetic diagram showing the humidifying section in the conventional internal humidification method. In a figure, the solid polyelectrolyte type fuel cell 10 adjoins the side attachment wall, and supplies the fuel gas and the oxidizer which provided with and humidified the humidifying section 11 of reactant gas, respectively to the fuel gas passage 6 and the oxidizing agent passage 7 of each single cell. The humidifying section 11 uses solid polymer membrane (membrane filter) without electron conductivity as the humidification service-water transmission films 12A and 12B, as shown in drawing 6, It is constituted so that the field side which is one side, respectively may counter the humidifying water passage 13 and the field of another side may counter the fuel gas humidification room 16 or the oxidizer humidification room 17, It is generated by the steam from the humidification service-water transmission film 12 surface which carried out humidity with the water heated by exhaust heat of the fuel cell, and the fuel gas and the oxidizer which were humidified with this steam are supplied to the fuel gas passage 6 and the oxidizing agent passage 7 of each single cell of the solid polyelectrolyte type fuel cell 10, respectively.

[0007]

[Problem(s) to be Solved by the Invention]In order to prevent the reactant gas humidified by the tank condensing in piping between fuel cells in an above-mentioned external humidification method, Since heat insulation and heating of piping are needed and the heat source for heating of a tank is needed, there is a problem of causing decline in the thermal efficiency of a solid polyelectrolyte type fuel cell, and there is a fault that a device also becomes large-scale.

[0008]On the other hand, since a fuel cell stack is adjoined and a humidifying section is arranged in an above-mentioned internal humidification method, use of exhaust heat of the fuel cell as a heat source of steam generating is easy, and there is an advantage which can also simplify the gas piping between a humidifying section and a fuel cell. However, a fuel cell is an isolated system which uses a poly membrane without the ion conductivity of a different body as a moisture transmission film, and the part mark also have the problem that and assembly operation becomes complicated. If a humidifying section can be laminated between the layers of a single cell, it is expected that it is possible to use the latent heat of vaporization of the makeup water for humidification for cooling of a fuel cell, and a humidifying section can be used also [cold plate], but. Since the conductivity of a stack will be lost if it laminates between the layers of a single cell, since a humidification service-water transmission film does not have electron conductivity, the problem that a humidifying section cannot be made to serve a double purpose

as a cold plate of a fuel cell also exists.
[0009]By uniting with a fuel cell stack, assembly operation is easy for the purpose of this invention, and its humidifying performance is good, and there is in acquiring the cellular structure of the solid polyelectrolyte type fuel cell provided with the humidifying section which can contribute also to cooling of a fuel cell.
[0010]
[Means for Solving the Problem]Solid polymer membrane which has ion conductivity according to this invention in order to solve an aforementioned problem, A single cell which consists of a fuel electrode and an oxidant electrode which were arranged by sticking to the both sides, In a solid polyelectrolyte type fuel cell laminated two or more layers via a bipolar plate which has a fuel gas passage and an oxidizing agent passage which become a portion which counters each said double-sided fuel electrode and oxidant electrode of a gas impermeability board from a concave, Length extension of predetermined is carried out at a method of both sides of said fuel electrode and an oxidant electrode which counter mutually, as a transmission film of moisture, this extension is provided in one extension and said solid polymer membrane provides a humidifying section of an oxidizer in a humidifying section of fuel gas, and an extension of another side.
[0011]A gas humidifying passage in which a humidifying section was formed as an extension of solid polymer membrane, and a concave which while pinches this and is opened for free passage to a bipolar plate in a fuel gas passage or an oxidizing agent passage, It shall consist of a water replenish passage formed as a concave which became independent into a portion which counters said gas humidifying passage of a bipolar plate of another side. Arrangement of a gas humidifying passage in two extensions of solid polymer membrane and a water replenish passage is mutually allotted to a symmetric position to solid polymer membrane, one side forms a humidifying section of fuel gas, and another side forms a humidifying section of an oxidizer.
[0012]A gas supplying passage is formed further again so that fuel gas or an oxidizer which passed along this may make a U-turn and it may flow into a fuel gas passage or an oxidizing agent passage.
[0013]
[Function]In the composition of this invention, the solid polymer membrane which has the ion conductivity of each single cell of a solid polyelectrolyte type fuel cell, Predetermined carried out length extension at the method of both sides of the fuel electrode and the oxidant electrode, and it constituted so that this extension might be provided in one extension and the humidifying section of an oxidizer might be provided in the humidifying section of fuel gas, and the extension of another side as a transmission film of moisture. Namely, the gas humidifying passage formed as a concave which while pinches solid polymer membrane and is open for free passage to a bipolar plate in a fuel gas passage or an oxidizing agent passage, If it constitutes so that the water replenish passage formed as a concave which became independent into the portion which counters the gas supplying passage of the bipolar plate of another side may be provided and it may be considered as a humidifying section, By forming in the bipolar plate the shape of the concave formed beforehand corresponding to the gas humidifying passage and the water replenish passage, Since the solid polyelectrolyte type fuel cell provided with the humidifying section of the reactant gas unified without changing most laminated structures of a solid polyelectrolyte type fuel cell for every single cell can be constituted, the function to avoid the increase in part mark and the number of assemblers is obtained. Since it excels in the humidifying performance of solid polymer membrane by that of humidifying section ****** for every single cell and the shift of moisture to a body part from the extension of solid polymer membrane can also be expected, the high dry preventing function of solid polymer membrane is obtained. Since the humidifying section united with both the sides of a single cell takes the power generation heat of formation of a single cell as the latent heat of vaporization of a steam, a humidifying section serves as a cold plate with quick speed of response, and the function to improve the temperature distribution of a solid polyelectrolyte type fuel cell is obtained.
[0014]If it constitutes so that arrangement of the gas supplying passage in two extensions of solid polymer membrane and a water replenish passage may be mutually made into a symmetric position to

solid polymer membrane, The humidifying section of fuel gas can be formed in one extension, without not exerting the humidifying section of an oxidizer on the extension of another side, but affecting the composition of a solid polyelectrolyte type fuel cell. If a gas supplying passage is formed further again so that the fuel gas or the oxidizer which passed along this may make a U-turn and it may flow into a fuel gas passage or an oxidizing agent passage, While not needing the supply path of the humidified reactant gas but being able to reduce the required surface product of a humidifying section to necessary minimum, the function which supplies a reactant gas passage and humidifies solid polymer membrane efficiently is obtained without making moisture condense.

[0015]

[Example]Hereafter, this invention is explained based on an example. The sectional view which, and is shown, [drawing 1] [the cellular structure of the solid polyelectrolyte type fuel cell which becomes an example of this invention] [**] [type] It is the top view in which drawing 2 looked at the bipolar plate in an example from the fuel gas passage side, and the top view in which drawing 3 looked at the bipolar plate in an example from the oxidizing agent passage side, and the duplicate explanation is omitted by giving the same reference mark to the same component part as conventional technology. The solid polymer membrane 22 which has the ion conductivity which constitutes a single cell in a figure, Length extension of predetermined is carried out at the method of both sides of the fuel electrode 3 and the oxidant electrode 4 which counter mutually via this, and the humidifying section 37 of an oxidizer is formed in one extension at the humidifying section 36 of fuel gas, and the extension of another side considering this extension as the transmission films 22A and 22B of moisture.

[0016]The humidifying section 36 of fuel gas uses the extension 22B of the solid polymer membrane 22 as the transmission film of moisture, The fuel gas humidifying passage 26 as a concave which while pinches this and is open for free passage to the bipolar plate 25A in the fuel gas passage 6 is formed, By forming the water replenish passage 24 which consists of a concave which became independent into the portion which counters the fuel gas humidifying passage 26 of the bipolar plate 25B of another side, the solid polyelectrolyte type fuel cell provided with the humidifying section 36 of the fuel gas united with each single cell is constituted. As the humidifying section 37 of an oxidizer, the extension 22A of the solid polymer membrane 22 is used as the transmission film of moisture, The oxidizer humidifying passage 27 as a concave which while pinches this and is open for free passage to the bipolar plate 25B in the oxidizing agent passage 7 is formed, By forming the water replenish passage 23 which consists of a concave which became independent into the portion which counters the oxidizer humidifying passage 27 of the bipolar plate 25A of another side, the solid polyelectrolyte type fuel cell provided with the humidifying section 37 of the fuel gas united with each single cell is constituted.

[0017]The humidifying section 36 of the fuel gas in one single cell and the humidifying section 37 of an oxidizer, By making mutually arrangement with the gas humidifying passages 26 and 27 in two extensions of solid polymer membrane, and the water replenish passages 23 and 24 into a symmetric position to solid polymer membrane, The fuel gas humidifying passage 26 which was open for free passage to the fuel gas passage 6, and the oxidizer humidifying passage 27 which was open for free passage to the oxidizing agent passage 7 can be formed in the form where the extension of the solid polymer membrane 22 of one sheet is used.

[0018]By the rib 28B which was connected and formed in the seal part 28 by the side of the bipolar plate 25A and 25B periphery in the water replenish passages 23 and 24 as shown in drawing 2 or drawing 3. It is formed with the gas passagewaies 6 and 7, and water works of makeup water are performed via the entrances 23A and 24A of the makeup water which penetrates the seal part 28, and the exits 23B and 24B, respectively. The humidifying passage 26 of fuel gas or the humidifying passage 27 of an oxidizer, It is formed so that it may have the rib 28A between the fuel gas passage 6 and the oxidizing agent passage 7, the fuel gas or the oxidizer passing through a humidifying passage may make a U-turn and it may flow into the fuel gas passage 6 or the oxidizing agent passage 7, While being able to supply a fuel gas passage or an oxidizing agent passage, without making the moisture in the reactant gas humidified in the humidifying passage condense, the area which a humidifying section occupies is reducible to the minimum.

[0019]The single cell which has the cellular structure which becomes an example the makeup water in the humidifying section 36 and 37, In response to the power generation heat of formation of a single cell, it is heated from a single cell to the extension of direct or the cold plate which is not illustrated, The fuel gas or the oxidizer which it was generated by the steam on the surface of the moisture transmission films 22A and 22B which carried out humidity, and the reactant gas in the humidifying passage 26 and 27 was humidified with this steam, and was humidified by the fuel gas passage 6 and the oxidizing agent passage 7 which were open for free passage to this is supplied.
[0020]In the solid polyelectrolyte type fuel cell constituted as a layered product of a single cell which has the cellular structure constituted in this way, By forming in the bipolar plate the shape of the concave formed beforehand corresponding to the gas humidifying passage and the water replenish passage, Since the solid polyelectrolyte type fuel cell provided with the humidifying section of the reactant gas unified without changing most laminated structures of a solid polyelectrolyte type fuel cell for every single cell can be constituted, While the increase in part mark and the number of assemblers is avoided and reduction of a manufacturing cost is attained, Since the function for a humidifying section to be provided for every single cell, and for moisture to shift to the body part of solid polymer membrane directly from the extension which the humidifying performance of reactant gas was good, and carried out humidity, and to prevent desiccation is added, The solid polyelectrolyte type fuel cell provided with the cellular structure which has advanced dry prevention performance can be obtained economically and advantageously.
[0021]Since the humidifying section united with both the sides of a single cell takes the power generation heat of formation of a single cell as the latent heat of vaporization of a steam, a humidifying section serves as the function of a cold plate with quick speed of response, and the advantage which can improve the temperature distribution of a solid polyelectrolyte type fuel cell is acquired.
[0022]
[Effect of the Invention]This invention was constituted so that the extension of the solid polymer membrane as an electrolyte membrane might be provided in one extension and it might provide the humidifying section of an oxidizer in the humidifying section of fuel gas, and the extension of another side as a transmission film of moisture as mentioned above. As a result, while not needing a humidification tank and gas piping but being able to simplify the composition of a device by uniting a humidifying section with a fuel cell compared with the solid polyelectrolyte type fuel cell of an external humidification method, Since the heat of formation of a fuel cell uses directly as a heat source for steam generating, thermal efficiency is high, and when each single cell is provided with a humidifying section, the solid polyelectrolyte type fuel cell provided with the cellular structure with high humidifying performance can be provided economically and advantageously.
[0023]In order that it may have the humidifying section united with the fuel cell body for every single cell compared with the solid polyelectrolyte type fuel cell of the conventional internal humidification method which put the humidifying section side by side to the fuel cell and the heat of formation of a fuel cell may use directly as a heat source for steam generating, the speed of response of the humidifying amount to change of single cell temperature -- it is high, and since supply of the moisture from the extension of solid polymer membrane to a body part is also directly expectable, the dry preventive effect of the outstanding solid polymer membrane is acquired. Since part mark and its number of assemblers can be reduced by being unified, the economic effect which can reduce a manufacturing cost substantially is acquired. Since the makeup water supplied to a humidifying section functions also as cooling water, the same chilling effect is acquired and the repercussion effect which improves the temperature distribution of the plane direction of a single cell and the laminating direction of a solid polyelectrolyte type fuel cell, and improves cell characteristics can also be expected to have formed the cold plate in each single cell.

[Translation done.]

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TECHNICAL FIELD

[Industrial Application]This invention relates to the solid polyelectrolyte type fuel cell stack which used solid polymer membrane as an electrolyte membrane, and the cellular structure for humidifying solid polymer membrane especially.

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PRIOR ART

[Description of the Prior Art]Drawing 4 is a sectional view [-izing / **/ the single-cell-structure of a solid polyelectrolyte type fuel cell / a sectional view / type / in which showing it] and and, and the single cell 1 comprises the solid polymer membrane 2 which has ion conductivity, and the fuel electrode (anode electrode) 3 and the oxidant electrode (cathode terminal) 4 which were supported so that it might stick to the both sides. The bipolar plate 5 which pinches the single cell 1 consists of a gas impermeability board which has conductivity, Power generation based on electrochemical reaction is performed by inter-electrode [of the couple of the single cell 1] by supplying oxygen as an oxidizer to the oxidizing agent passage 7 formed in the fuel gas passage 6 formed in the field side which touches the fuel electrode 3 as a concave as a concave in hydrogen as fuel gas at the field side which touches the oxidant electrode 4. Since the output voltage of the single cell 1 constituted in this way is as low as less than 1V, the solid polyelectrolyte type fuel cell of desired output voltage is obtained by laminating the single cell 1 and the two or more layers bipolar plate 5, and constituting a stack.
[0003]On the other hand as the solid polymer membrane 1 which has ion conductivity, For example, the thing using the perphloro carbon sulfonic acid film (the U.S., Du Pont, trade name Nafion) which is proton exchange membrane as an electrolyte membrane is known, While the specific resistance of 20 or less ohm-cm is shown and functioning as a proton conductivity electrolyte at ordinary temperature by having and carrying out the saturation water of the proton (hydrogen ion) exchange group into a molecule, it functions also as barrier membrane which prevents mixing of fuel gas and oxidant gas. Namely, the anode reaction ($H_2 \rightarrow 2H^+ + 2e^-$) which decomposes a hydrogen content child into a hydrogen ion and an electron in the anode electrode (fuel electrode) side, in the cathode terminal (oxidant electrode) side, water is generated from oxygen, a hydrogen ion, and an electron -- electrochemical reaction ($2H^+ + 1/2\ O_2 + 2e^- \rightarrow H_2O$) -- a cathode reaction being performed, respectively and, Electrochemical reaction which $2\ O_2 \rightarrow H_2O$ [$H_2 + 1/$] Becomes as a whole is performed, and generated output is supplied to load with the electron which moves toward a cathode in an external circuit from an anode.
[0004]As mentioned above, **********, While maintaining the inside of the solid polymer membrane 2 to a saturation moisture state in order to maintain highly the generation efficiency of a solid polyelectrolyte type fuel cell since a film functions as proton exchange membrane by carrying out the saturation water of the electrolyte membrane, It is necessary to hold the operating temperature of a solid polyelectrolyte type fuel cell to a 50-100 degreeC grade, and to keep the specific resistance of solid polymer membrane low. For this reason, after the solid polyelectrolyte membrane 2 of each single cell 1 has carried out the water of the water of a saturation content beforehand, assembly operation of a stack is performed. However, if it generates electricity by raising an operating temperature to the above-mentioned temperature requirement, the drying effect of the solid polymer membrane 2 shown below occurs, the solid polymer membrane 2 cannot be maintained to a saturation moisture state, but the problem that the generation efficiency of a solid polyelectrolyte type fuel cell falls will occur. Namely, while the water generated by electrochemical reaction with fuel gas and

oxidant gas is carried out out of a system, When proton $2H^+$ generated in the anode reaction turns the inside of solid polymer membrane to a cathode from an anode and moves, desiccation of solid polymer membrane advances by a child's water carrying out orientation to a proton several minutes, moving to it together, and being carried out out of a system with fuel gas and an oxidizer.

[0005]Then, in order to avoid such a situation, water is added to the reactant gas (fuel gas and oxidizer) supplied to the reactant gas passages 6 and 7, the steam concentration (steam partial pressure) in reactant gas is raised, and what was constituted so that evaporation of the moisture from the solid polymer membrane 2 might be suppressed is known. The tank which collected warm water is prepared for the exterior of a fuel cell as a humidifying method of reactant gas, and the external humidifying method which supplies the reactant gas which BABURINKU, humidified and humidified reactant gas in this hot water to each single cell of a solid polyelectrolyte type fuel cell is known. A solid polyelectrolyte type fuel cell is adjoined, a humidifying section is provided, and the internal humidifying method which supplies the reactant gas humidified here to each single cell is also known.

[0006]The mimetic diagram and drawing 6 in which the solid polyelectrolyte type fuel cell of the former [drawing 5] of an internal humidification method is shown are a mimetic diagram showing the humidifying section in the conventional internal humidification method. In a figure, the solid polyelectrolyte type fuel cell 10 adjoins the side attachment wall, and supplies the fuel gas and the oxidizer which provided with and humidified the humidifying section 11 of reactant gas, respectively to the fuel gas passage 6 and the oxidizing agent passage 7 of each single cell. The humidifying section 11 uses solid polymer membrane (membrane filter) without electron conductivity as the humidification service-water transmission films 12A and 12B, as shown in drawing 6, It is constituted so that the field side which is one side, respectively may counter the humidifying water passage 13 and the field of another side may counter the fuel gas humidification room 16 or the oxidizer humidification room 17, It is generated by the steam from the humidification service-water transmission film 12 surface which carried out humidity with the water heated by exhaust heat of the fuel cell, and the fuel gas and the oxidizer which were humidified with this steam are supplied to the fuel gas passage 6 and the oxidizing agent passage 7 of each single cell of the solid polyelectrolyte type fuel cell 10, respectively.

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EFFECT OF THE INVENTION

[Effect of the Invention]This invention was constituted so that the extension of the solid polymer membrane as an electrolyte membrane might be provided in one extension and it might provide the humidifying section of an oxidizer in the humidifying section of fuel gas, and the extension of another side as a transmission film of moisture as mentioned above. As a result, while not needing a humidification tank and gas piping but being able to simplify the composition of a device by uniting a humidifying section with a fuel cell compared with the solid polyelectrolyte type fuel cell of an external humidification method, Since the heat of formation of a fuel cell uses directly as a heat source for steam generating, thermal efficiency is high, and when each single cell is provided with a humidifying section, the solid polyelectrolyte type fuel cell provided with the cellular structure with high humidifying performance can be provided economically and advantageously.
[0023]In order that it may have the humidifying section united with the fuel cell body for every single cell compared with the solid polyelectrolyte type fuel cell of the conventional internal humidification method which put the humidifying section side by side to the fuel cell and the heat of formation of a fuel cell may use directly as a heat source for steam generating, the speed of response of the humidifying amount to change of single cell temperature -- it is high, and since supply of the moisture from the extension of solid polymer membrane to a body part is also directly expectable, the dry preventive effect of the outstanding solid polymer membrane is acquired. Since part mark and its number of assemblers can be reduced by being unified, the economic effect which can reduce a manufacturing cost substantially is acquired. Since the makeup water supplied to a humidifying section functions also as cooling water, the same chilling effect is acquired and the repercussion effect which improves the temperature distribution of the plane direction of a single cell and the laminating direction of a solid polyelectrolyte type fuel cell, and improves cell characteristics can also be expected to have formed the cold plate in each single cell.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]In order to prevent the reactant gas humidified by the tank condensing in piping between fuel cells in an above-mentioned external humidification method, Since heat insulation and heating of piping are needed and the heat source for heating of a tank is needed, there is a problem of causing decline in the thermal efficiency of a solid polyelectrolyte type fuel cell, and there is a fault that a device also becomes large-scale.
[0008]On the other hand, since a fuel cell stack is adjoined and a humidifying section is arranged in an above-mentioned internal humidification method, use of exhaust heat of the fuel cell as a heat source of steam generating is easy, and there is an advantage which can also simplify the gas piping between a humidifying section and a fuel cell. However, a fuel cell is an isolated system which uses a poly membrane without the ion conductivity of a different body as a moisture transmission film, and the part mark also have the problem that and assembly operation becomes complicated. If a humidifying section can be laminated between the layers of a single cell, it is expected that it is possible to use the latent heat of vaporization of the makeup water for humidification for cooling of a fuel cell, and a humidifying section can be used also [cold plate], but. Since the conductivity of a stack will be lost if it laminates between the layers of a single cell, since a humidification service-water transmission film does not have electron conductivity, the problem that a humidifying section cannot be made to serve a double purpose as a cold plate of a fuel cell also exists.
[0009]By uniting with a fuel cell stack, assembly operation is easy for the purpose of this invention, and its humidifying performance is good, and there is in acquiring the cellular structure of the solid polyelectrolyte type fuel cell provided with the humidifying section which can contribute also to cooling of a fuel cell.

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MEANS

[Means for Solving the Problem]Solid polymer membrane which has ion conductivity according to this invention in order to solve an aforementioned problem, A single cell which consists of a fuel electrode and an oxidant electrode which were arranged by sticking to the both sides, In a solid polyelectrolyte type fuel cell laminated two or more layers via a bipolar plate which has a fuel gas passage and an oxidizing agent passage which become a portion which counters each said double-sided fuel electrode and oxidant electrode of a gas impermeability board from a concave, Length extension of predetermined is carried out at a method of both sides of said fuel electrode and an oxidant electrode which counter mutually, as a transmission film of moisture, this extension is provided in one extension and said solid polymer membrane provides a humidifying section of an oxidizer in a humidifying section of fuel gas, and an extension of another side.
[0011]A gas humidifying passage in which a humidifying section was formed as an extension of solid polymer membrane, and a concave which while pinches this and is opened for free passage to a bipolar plate in a fuel gas passage or an oxidizing agent passage, It shall consist of a water replenish passage formed as a concave which became independent into a portion which counters said gas humidifying passage of a bipolar plate of another side. Arrangement of a gas humidifying passage in two extensions of solid polymer membrane and a water replenish passage is mutually allotted to a symmetric position to solid polymer membrane, one side forms a humidifying section of fuel gas, and another side forms a humidifying section of an oxidizer.
[0012]A gas supplying passage is formed further again so that fuel gas or an oxidizer which passed along this may make a U-turn and it may flow into a fuel gas passage or an oxidizing agent passage.

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OPERATION

[Function]In the composition of this invention, the solid polymer membrane which has the ion conductivity of each single cell of a solid polyelectrolyte type fuel cell, Predetermined carried out length extension at the method of both sides of the fuel electrode and the oxidant electrode, and it constituted so that this extension might be provided in one extension and the humidifying section of an oxidizer might be provided in the humidifying section of fuel gas, and the extension of another side as a transmission film of moisture. Namely, the gas humidifying passage formed as a concave which while pinches solid polymer membrane and is open for free passage to a bipolar plate in a fuel gas passage or an oxidizing agent passage, If it constitutes so that the water replenish passage formed as a concave which became independent into the portion which counters the gas supplying passage of the bipolar plate of another side may be provided and it may be considered as a humidifying section, By forming in the bipolar plate the shape of the concave formed beforehand corresponding to the gas humidifying passage and the water replenish passage, Since the solid polyelectrolyte type fuel cell provided with the humidifying section of the reactant gas unified without changing most laminated structures of a solid polyelectrolyte type fuel cell for every single cell can be constituted, the function to avoid the increase in part mark and the number of assemblers is obtained. Since it excels in the humidifying performance of solid polymer membrane by that of humidifying section ****** for every single cell and the shift of moisture to a body part from the extension of solid polymer membrane can also be expected, the high dry preventing function of solid polymer membrane is obtained. Since the humidifying section united with both the sides of a single cell takes the power generation heat of formation of a single cell as the latent heat of vaporization of a steam, a humidifying section serves as a cold plate with quick speed of response, and the function to improve the temperature distribution of a solid polyelectrolyte type fuel cell is obtained.
[0014]If it constitutes so that arrangement of the gas supplying passage in two extensions of solid polymer membrane and a water replenish passage may be mutually made into a symmetric position to solid polymer membrane, The humidifying section of fuel gas can be formed in one extension, without not exerting the humidifying section of an oxidizer on the extension of another side, but affecting the composition of a solid polyelectrolyte type fuel cell. If a gas supplying passage is formed further again so that the fuel gas or the oxidizer which passed along this may make a U-turn and it may flow into a fuel gas passage or an oxidizing agent passage, While not needing the supply path of the humidified reactant gas but being able to reduce the required surface product of a humidifying section to necessary minimum, the function which supplies a reactant gas passage and humidifies solid polymer membrane efficiently is obtained without making moisture condense.

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EXAMPLE

[Example]Hereafter, this invention is explained based on an example. The sectional view which, and is shown, [drawing 1] [the cellular structure of the solid polyelectrolyte type fuel cell which becomes an example of this invention] [**] [type] It is the top view in which drawing 2 looked at the bipolar plate in an example from the fuel gas passage side, and the top view in which drawing 3 looked at the bipolar plate in an example from the oxidizing agent passage side, and the duplicate explanation is omitted by giving the same reference mark to the same component part as conventional technology. The solid polymer membrane 22 which has the ion conductivity which constitutes a single cell in a figure, Length extension of predetermined is carried out at the method of both sides of the fuel electrode 3 and the oxidant electrode 4 which counter mutually via this, and the humidifying section 37 of an oxidizer is formed in one extension at the humidifying section 36 of fuel gas, and the extension of another side considering this extension as the transmission films 22A and 22B of moisture.
[0016]The humidifying section 36 of fuel gas uses the extension 22B of the solid polymer membrane 22 as the transmission film of moisture, The fuel gas humidifying passage 26 as a concave which while pinches this and is open for free passage to the bipolar plate 25A in the fuel gas passage 6 is formed, By forming the water replenish passage 24 which consists of a concave which became independent into the portion which counters the fuel gas humidifying passage 26 of the bipolar plate 25B of another side, the solid polyelectrolyte type fuel cell provided with the humidifying section 36 of the fuel gas united with each single cell is constituted. As the humidifying section 37 of an oxidizer, the extension 22A of the solid polymer membrane 22 is used as the transmission film of moisture, The oxidizer humidifying passage 27 as a concave which while pinches this and is open for free passage to the bipolar plate 25B in the oxidizing agent passage 7 is formed, By forming the water replenish passage 23 which consists of a concave which became independent into the portion which counters the oxidizer humidifying passage 27 of the bipolar plate 25A of another side, the solid polyelectrolyte type fuel cell provided with the humidifying section 37 of the fuel gas united with each single cell is constituted.
[0017]The humidifying section 36 of the fuel gas in one single cell and the humidifying section 37 of an oxidizer, By making mutually arrangement with the gas humidifying passages 26 and 27 in two extensions of solid polymer membrane, and the water replenish passages 23 and 24 into a symmetric position to solid polymer membrane, The fuel gas humidifying passage 26 which was open for free passage to the fuel gas passage 6, and the oxidizer humidifying passage 27 which was open for free passage to the oxidizing agent passage 7 can be formed in the form where the extension of the solid polymer membrane 22 of one sheet is used.
[0018]By the rib 28B which was connected and formed in the seal part 28 by the side of the bipolar plate 25A and 25B periphery in the water replenish passages 23 and 24 as shown in drawing 2 or drawing 3. It is formed with the gas passagewaies 6 and 7, and water works of makeup water are performed via the entrances 23A and 24A of the makeup water which penetrates the seal part 28, and the exits 23B and 24B, respectively. The humidifying passage 26 of fuel gas or the humidifying passage 27 of an oxidizer, It is formed so that it may have the rib 28A between the fuel gas passage 6 and the oxidizing agent passage 7, the fuel gas or the oxidizer passing through a humidifying passage may make

a U-turn and it may flow into the fuel gas passage 6 or the oxidizing agent passage 7, While being able to supply a fuel gas passage or an oxidizing agent passage, without making the moisture in the reactant gas humidified in the humidifying passage condense, the area which a humidifying section occupies is reducible to the minimum.

[0019]The single cell which has the cellular structure which becomes an example the makeup water in the humidifying section 36 and 37, In response to the power generation heat of formation of a single cell, it is heated from a single cell to the extension of direct or the cold plate which is not illustrated, The fuel gas or the oxidizer which it was generated by the steam on the surface of the moisture transmission films 22A and 22B which carried out humidity, and the reactant gas in the humidifying passage 26 and 27 was humidified with this steam, and was humidified by the fuel gas passage 6 and the oxidizing agent passage 7 which were open for free passage to this is supplied.

[0020]In the solid polyelectrolyte type fuel cell constituted as a layered product of a single cell which has the cellular structure constituted in this way, By forming in the bipolar plate the shape of the concave formed beforehand corresponding to the gas humidifying passage and the water replenish passage, Since the solid polyelectrolyte type fuel cell provided with the humidifying section of the reactant gas unified without changing most laminated structures of a solid polyelectrolyte type fuel cell for every single cell can be constituted, While the increase in part mark and the number of assemblers is avoided and reduction of a manufacturing cost is attained, Since the function for a humidifying section to be provided for every single cell, and for moisture to shift to the body part of solid polymer membrane directly from the extension which the humidifying performance of reactant gas was good, and carried out humidity, and to prevent desiccation is added, The solid polyelectrolyte type fuel cell provided with the cellular structure which has advanced dry prevention performance can be obtained economically and advantageously.

[0021]Since the humidifying section united with both the sides of a single cell takes the power generation heat of formation of a single cell as the latent heat of vaporization of a steam, a humidifying section serves as the function of a cold plate with quick speed of response, and the advantage which can improve the temperature distribution of a solid polyelectrolyte type fuel cell is acquired.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The sectional view [-izing / **/ the cellular structure of the solid polyelectrolyte type fuel cell which becomes an example of this invention / sectional view / type / in which showing it] and and
[Drawing 2]The top view which looked at the bipolar plate in an example from the fuel gas passage side
[Drawing 3]The top view which looked at the bipolar plate in an example from the oxidizing agent passage side
[Drawing 4]The sectional view [-izing / **/ the single-cell-structure of a solid polyelectrolyte type fuel cell / sectional view / type / in which showing it] and and
[Drawing 5]The mimetic diagram showing the conventional solid polyelectrolyte type fuel cell of an internal humidification method
[Drawing 6]The mimetic diagram showing the humidifying section in the conventional internal humidification method
[Description of Notations]
1 Single cell
2 Solid polymer membrane
3 Fuel electrode
4 Oxidant electrode
5 Bipolar plate
6 Fuel gas passage
7 Oxidizing agent passage
8 Gas seal part (rib)
10 Solid polyelectrolyte type fuel cell (stack)
11 Humidifying section
12 Humidification service-water transmission film
13 Humidifying water passage
16 Fuel gas humidification room
17 Oxidizer humidification room
22 Solid polymer membrane
22A The extension of solid polymer membrane (moisture transmission film)
22B The extension of solid polymer membrane (moisture transmission film)
23 Water replenish passage
24 Water replenish passage
25A Bipolar plate
25B Bipolar plate
26 Fuel gas humidifying passage
27 Oxidizer humidifying passage
28 Seal part
28A Rib (for gas U-turn)

28B Rib (for formation of a water replenish passage)
36 Fuel gas humidifying section
37 Oxidizer humidifying section

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